

## NOTES AND COMMENTS

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### NOTES ON BROODING BEHAVIOR IN THE SAWFLY *NEMATUS TILIAE* (HYMENOPTERA: TENTHREDINIDAE: NEMATINAE)

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The term 'subsocial insects' has been used to refer to those which provide parental care for their offspring (Eickwort, 1981; Tallamy and Wood, 1986). Such subsocial behavior has been regarded as one of the prerequisites for the evolution of eusociality in insects (Wilson, 1971). In Hymenoptera with haplo-diploidy which promotes social evolution (Hamilton, 1964), a continuum of social habits, nest construction, guarding offspring, provisioning, communal breeding and reproductive caste differentiation, is found among species of Apocrita (Wilson, 1971). However, despite sharing the same genetic system, basic parental attendance without nesting is the most developed form of sociality in Symphyta and has hitherto been described in relatively few species (Takizawa, 1957; Dias, 1975; 1976; Naumann, 1984; Shinohara, 1986; Kudo et al., 1992; Macdonald and Ohmart, 1993). To analyze comprehensively the evolution of sociality in the Hymenoptera, further information on social behavior in a variety of taxa including primitive ones will be needed. Here we report new observations on apparent brooding behavior in *Nematus tiliae* Zinovjev.

Observations were carried out in Meiji, Akaigawa, Hokkaido, Japan (43°00.82'N, 140°53.89'E). This sawfly was extremely rare; only three clutches with females were found in early September 1996, and none were discovered in 1997 despite intensive investigations at the same site. The clutches were deposited on the underside of leaves in the most apical position of shoots on a Japanese linden, *Tilia maximowicziana* Shirasawa. Two clutches, an egg-mass and an egg-shell mass with first-instar larvae, and the imprint of an egg-mass (without larvae) were found on one leaf. The eggs of one egg-mass hatched soon after discovery. Another clutch, first-instar larvae with an egg-shell mass, was on a different leaf. Accurate clutch size could not be determined, but was estimated at 90–140 by counting hatched larvae and the remaining egg shells.

In subsocial insects, especially in non-nesting species, parent females often show a remarkable posture of attendance and respond against disturbance with specific guarding behavior (Eickwort, 1981; Tallamy and Wood, 1986). All three *Nematus* females discovered straddled the egg-mass (Fig. 1), as in some other subsocial sawflies (e.g., Dias, 1975). When the brooding females were disturbed with visual or tactile stimuli, they showed aggressive responses, opening their mandibles and fanning their wings. Larvae that had hatched from three clutches dispersed on natal leaves and individually fed on them making small holes. Nevertheless, females remained in the same posture on the egg-shell masses, and like the females attending egg-masses, they retained their aggressive responses against disturbance. Even when the brooding females were prodded repeatedly with a pair of forceps, they never



Fig. 1. A *Nematus tiliae* female straddling an egg mass on a *Tilia* leaf.

moved from the egg-mass or the egg-shell mass. This sawfly is most likely to be semelparous.

The function of brooding females seems to be physical defense of their eggs against natural enemies, as was shown in the pamphiliid sawfly *Cephalcia isschikii* Takeuchi (Kudo et al., 1992) and other subsocial insects (Tallamy and Wood, 1986; Trumbo, 1996). Further observations and experiments will clarify the adaptive significance of maternal behavior in this sawfly.—*Shin-ichi Kudo*,<sup>1</sup> *Masahiro Ohara*,<sup>2</sup> and *Akihiko Shinohara*<sup>3</sup>, <sup>1</sup>*Department of Biology, Naruto University of Education, Naruto, Tokushima, 772-8502 Japan;* <sup>2</sup>*Systematic Entomology, Faculty of Agriculture, Hokkaido University, Sapporo, Hokkaido, 060-8589 Japan;* <sup>3</sup>*Department of Zoology, National Science Museum (Natural History), Tokyo, 169-0073 Japan.*

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